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(54) Improvement in the washload drying arrangement of dishwashing machines

(57) Dishwashing machine comprising a washing tank (1) provided with an upper aperture (6) and a lower aperture (7) that are interconnected through a conduit (8) extending outside the tank. During drying, the vapour in the tank is caused to circulate along a closed-loop flow-path defined by the tank and the conduit (8), thereby reducing to a minimum the effect of thermal stratification of the vapour in the tank and, as a result, favouring a homogeneous drying effect of the washload items.

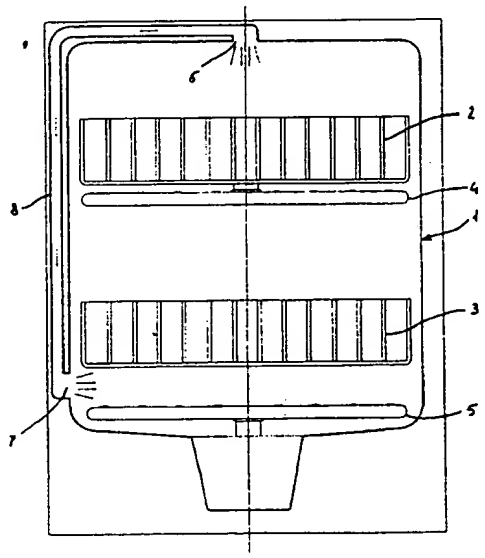

Fig. 1

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Description

The present invention refers to a dishwashing machine provided with an improved arrangement for drying the washload in a system where the vapour released by the washload accomodated in a washing tank tends to condense mainly on the inner walls of the same washing tank. In other words, the present invention refers to a dishwashing machine which is adapted to dry the washload without using any special system provided with a condenser.

Dishwashing machines with washload drying systems provided with a condenser arrangement are largely known in the art. As disclosed for instance in US-A- 273 061, a specially provided condenser arranged in the washing tank of a dishwashing machine is traversed by a flow of cooling ambient air circulated therethrough by a fan. The vapour which is present in the washing tank at the end of a rinsing phase carried out with hot water, condenses on to the outer walls of the condenser, thereby promoting an efficient drying of the washload items.

Solutions are also well known, for instance from US-A-5 056 543, in which the moisture-laden hot air present in the washing tank is circulated directly through the condenser (where it cools down and gives off its humidity) which can possibly be associated to auxiliary cooling means.

In any case, all such known drying arrangements making use of a consenser have a drawback in that the moisture-laden hot air contained in the washing tank of the machine can cool down to an excessive extent when in contact with the condenser, thereby cooling down the washload to be dried correspondingly. As a result, the evaporation of the water from the washload is reduced, so that it becomes necessary for the washload to be submitted to forced heating, which is usually performed by appropriately operating the heating elements of the machine "in air", ie. under dry conditions, when they are not wetted by the washing or rinsing liquor. As commonly known, this gives rise to undesired effects of possible overheating of component parts of the machine and places additional stresses on to the electromechanical and/or electronic interfaces associated to the heating elements themselves. This adds to the fact that the provision of a condenser and the component parts that are usually associated therewith undesirably complicates the structure of the whole dishwashing machine and substantially increases the manufacturing and operating costs thereof.

On the other hand, in the dishwashing machines of the traditional type that are not equipped with a condenser for the drying operation, the vapour that is produced inside the washing tank at the end of a rinsing phase carried out with hot water generally gives rise an undesired thermal stratification. In particular, the temperature of such a vapour is higher in the upper portion of the tank interior (where at least a first washload holding rack or basket is usually provided), while it is lower in the lower portion of the same tank interior, where at least a second washload holding rack is usually provided. The temperature of the washload items in the different holding racks will of course be correspondingly different. For instance, approx. 10 minutes from the conclusion of a rinse carried out with water which had been heated up to 65°C and subsequently let off the machine, the temperature of the vapour inside the washing tank of the machine will tend to differentiate from a maximum of approx. 65°C, in correspondence of the ceiling of the washing tank, to a minimum of approx. 25°C in correspondence of the bottom of the same washing tank.

It is substantially in these conditions that the washload drying process takes place owing to the evaporation of residual water from the same washload items during a subsequent pause in the operation of the machine. The vapour released by the washload items tends to condensate mainly on the inner walls of the washing tank, which during this period of time tend to cool down, in a substantially homogeneous manner, more rapidly than the washload items themselves. Since the extent to which the washload items are able to dry is proportional to the thermal difference existing between the washload items themselves and the walls of the washing tank, the result is that the (colder) washload items arranged in the lower rack get dry in a less efficient manner than the warmer washload items arranged in the upper rack. In practice, the extent to which the washload items in the lower rack get dry is sometimes quite unsatisfactory. Anyway, the overall drying effect of the washload items in the washing tank of the machine appears to be undesirably non-homogeneous.

It is therefore a common practice to try to improve the drying effect of the washload items in a dishwashing machine by providing, as this is for instance described in the Italian utility model application no. PN91 U 000045, means that are adapted to bring about, when the machine is not operating, a natural circulation of ambient air through the washing tank of the dishwashing machine. Such a solution is however associated with an important drawback in that the dishwashing machine is able to release vapour into the surrounding ambient atmosphere, thereby giving rise to a number of practical problems as anyone skilled in the art is well aware of.

FR-A-1 116 585 discloses a dishwasher with a wash tub in which a propeller is provided to project water onto the crockery for washing purposes. To dry the crockery, the propeller is subsequently operated to agitate hot air inside the wash tub so that vapour released by the crockery is brought into contact with the walls of the wash tub, where it is condensed. Thermal stratification is however not prevented in an effective way in the whole wash tub, and in fact the walls of the tub itself must not be thermally isolated in order to be kept sufficiently cold, thereby enabling condensation of vapour thereon. In other words, the cold walls of the wash tub operate as a condenser. As a consequence,

unacceptable thermal losses occur through the walls of the wash tub during the wash cycles.

It is therefore a main purpose of the present invention to provide a dishwashing machine provided with a simple improved arrangement adapted to enable the washload items to be dried in a substantially homogeneous manner without substantially causing any vapour to be released into the surrounding ambient.

In particular, it is a purpose of the present invention to provide a dishwashing machine of the above cited kind, which is capable of drying the washload items in an effective manner without requiring the use of any purpose-provided condenser-based drying arrangement.

According to the present invention, these aims are reached in a dishwashing machine with improved washload drying arrangement embodying the features as recited in the appended claims.

The characteristics and the advantages of the invention will be more clearly and readily apparent from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematic view illustrating only the main component parts of a preferred embodiment of the dishwashing machine according to the present invention, and

- Figure 2 is a schematical view of a variant of the dishwashing machine illustrated in Figure 1.

Referring particularly to Figure 1, it can be seen that the dishwashing machine is of an automatic type and comprises mainly a washing tank 1 accomodating at least an upper rack 2 and at least a lower rack 3 intended to hold respective washload items (not shown) that are washed and/or rinsed in a traditional manner by means of rotating spray arms 4, 5, or similar means, each one of them arranged below a respective rack.

For reasons of greater simplicity, the means through which the rotating spray arms 4, 5 are supplied with water under pressure in a *per sè* known manner are not shown, nor are shown the heating means with which the water supplied to said rotating spray arms can be heated up, even in this case in a *per sè* known manner, in accordance with the operation cycles being performed by the machine.

The dishwashing machine may generally operate in a substantially traditional manner, ie. is capabole of performing operation cycles, at least one of which comprises a final washload rinse phase carried out with hot water (eg. at a temperature of 65°C).

According to the present invention, the machine comprises flow-promoting or flow-generating means adapted to cause a circulation (or turbulence) of the vapour being present inside the washing tank 1 to take place during a drying phase following the above cited final rinse phase.

In a preferred manner, said flow-generating means comprise at least an upper aperture 6 and at least a lower aperture 7 that are provided in the washing tank 1 and are interconnected through at least a conduit 8 which is arranged outside the washing tank and preferably extends in the cavity comprised between the tank 1 and the outer casing of the machine. As a result, during the washload drying phase a natural circulation of the vapour (in the direction indicated by the arrows in Figure 1) occurs along a closed-loop flow-path defined by the tank 1 and the conduit 8, said circulation tending in such manner to involve the washload items contained in the racks 2, 3 and to promote a substantial evenness of the vapour temperature throughout the interior of the washing tank.

The aperture 6 will of course be preferably provided in correspondence of the ceiling of the washing tank, while the aperture 7 will preferably be provided in a point adjacent to the bottom of the same washing tank.

As it has also been found experimentally in a dishwashing machine of a traditional type and general sizing, during a drying phase following a rinse performed with water at 65°C the above cited natural circulation of the vapour along the flow-path 1, 6, 7, 8 is capable of reducing the thermal stratification of the vapour inside the washing tank to a substantial extent. In particular, approx. 10 minutes after the rinsing water has been let off the machine the temperature of the vapour tends to differentiate from a maximum of approx. 50°C in correspondence of the ceiling of the tank, to a minimum of approx. 35°C in correspondence of the bottom of the same tank. Therefore, in a quite advantageous and, at the same time, very simple manner, the temperature of the washload items tends to become uniform so as to enable the same washload items to dry in a substantially homogeneous manner owing to the evaporation of the residual water which, in a *per sè* known manner, tends to condense onto the colder inner walls of the washing tank 1.

In other words, as compared to traditional solutions, the temperature of the washload items in the upper rack 2 stays at a value which is sufficient to make sure that the same washload items are able to dry adequately, while the temperature of the washload items in the lower rack 3 increases to such an extent as to prevent the same washload items from drying in an incomplete or, anyhow, inadequate manner.

It should additionally be noticed that the drying effect of the washload items is actually improved by the ventilation which they are subjct to due to the effect of the afore mentioned circulation of the vapour. Furthermore, in a quite advantageous manner the vapour itself is not released into the surrounding environment, thereby doing away with the drawbacks typically associated with such a release.

With reference to Figure 2, it can be noticed that the drying effect of the washload items in the dishwashing machine can be further improved by increasing the speed at which the flow of vapour is circulated along

said closed-loop flow-path 1, 6, 7, 8 by means oof a motor-driven fan 9 or similar means which may for instance be situated in correspondence of the upper aperture 6.

As it has also been found experimentally, during a drying phase following a rinsing phase carried out with water at 65°C the above cited circulation of the vapour along the flow-path 1, 6, 7, 8, when assisted by such a fan or similar means 9, does substantially away with the typical thermal stratification of the vapour inside the washing tank. In particular, the temperature of the vapour tends to become uniform throughout the interior of the tank, where it reaches a value of approx. 47°C after approx. 10 minutes from the rinsing water having been let off the machine.

It will of course be appreciated that the afore described dishwashing machine may be subject to a number of modifications and variations without departing from the scope of the present invention.

Claims

1. Dishwashing machine adapted to perform operational cycles, of which at least one comprises a phase carried out with hot water for rinsing the washload items that are arranged in a washing tank and that, during a subsequent drying phase, release inside said tank, owing to the evaporation of residual water from the same washload items, vapour that tends to condense mainly onto the inner walls of the tank, **characterized in that** at least an upper aperture (6) and at least a lower aperture (7) in said tank (1) are interconnected by at least a conduit (8) extending outside the tank and capable of bringing about a circulation of said vapour along a closed-loop flow-path defined by said tank (1) and said conduit (8), so as to cause the temperature of said vapour to become substantially homogeneous inside the tank, thereby improving the drying effect of the washload items.

2. Dishwashing machine according to claim 1, **characterized in that** in said closed-loop flow-path there is provided at least a fan means (9).

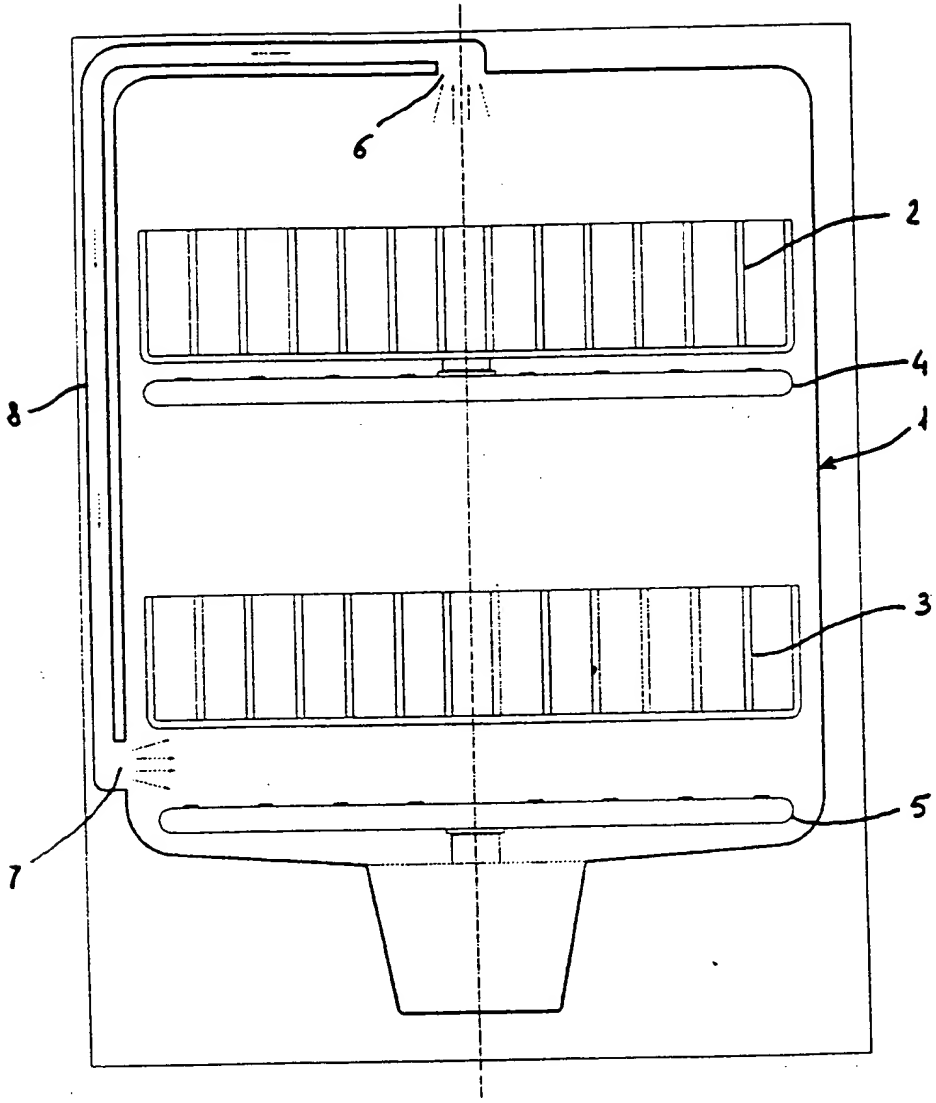

Fig. 1

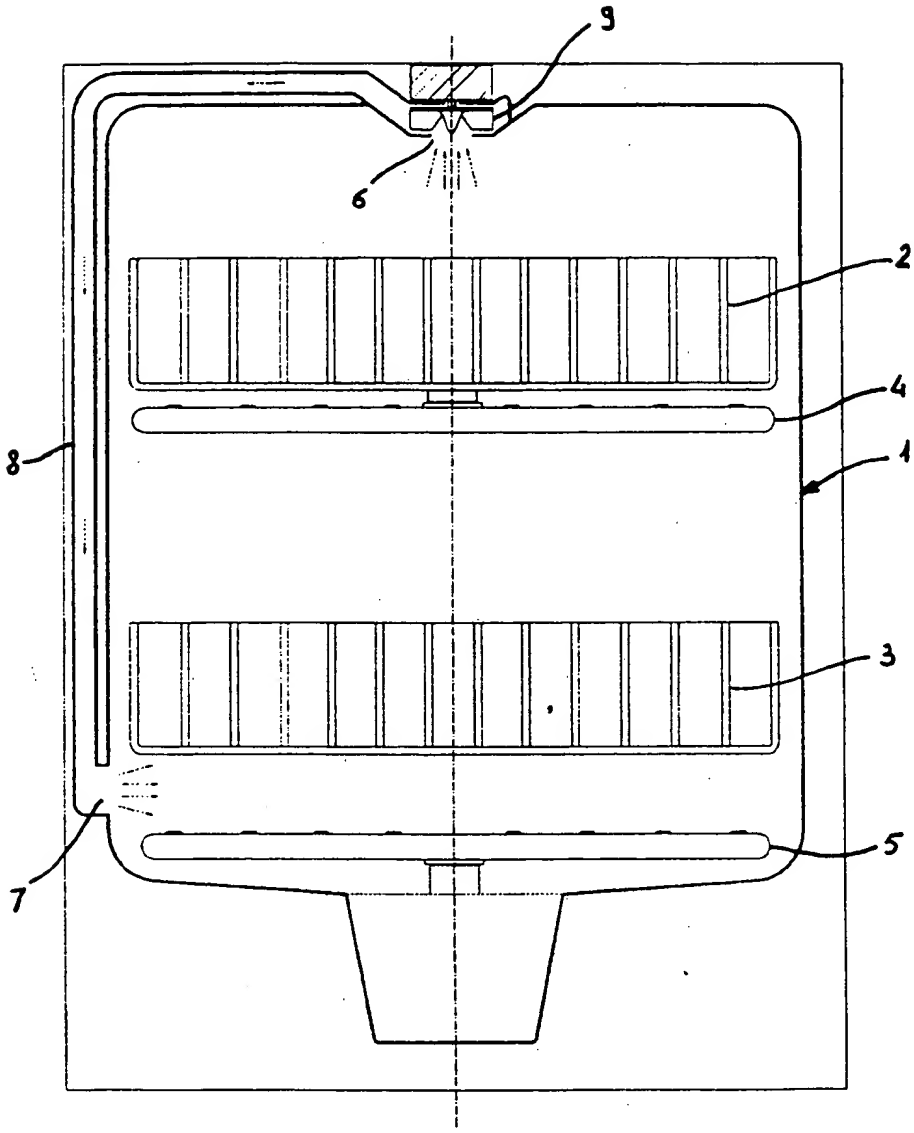

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 2503

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	FR 1 116 585 A (AVCO MANUFACTURING CORPORATION) * claims; figure 1 *	1,2	A47L15/48
A	GB 2 263 969 A (K.K. TOSHIBA) * page 8, line 11 - page 11; figure 1 *	1,2	
A	EP 0 239 012 A (MIELE & CIE GMBH) * column 2, line 45 - line 53; figure *	1,2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 July 1997	Courrier, G

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